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The Co-Evolutionary City [1)]

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This paper describes the concept of a co-evolutionary city as the nexus of three forces: economic, social and ecological. Both a static and a dynamic perspective is offered, while also different policy forces, viz. technology and land use, are discussed. In combination with market principles, urban co-evolutionary policies may offer a powerful contribution to the achievement of sustainable development of cities.

Cities in Perspectives

The concern about resources and quality of life in the post-war period is far from new. Since the early 1960s already, when Rachel Carson's 'The Silent Spring' attracted much attention, there has been an increasing awareness of the extensive damage to the environment caused by pollution. An avalanche of literature has been published since the 1980s on the pervasiveness of environmental decay ranging from local to even global scales and culminating in the widely cited Brundtland Report. Sustainable development has clearly a global dimension, but in recent years it is increasingly recognized that there is a close mutual interaction between local and global processes. Localities (e.g., cities, villages) are open spatial economic and ecological systems impacting on all other areas and on the earth as a whole. The recognition that much of the sustainability debate has an urban focus is also based on the fact that cities are large consumers of natural resources and major producers of pollution and waste. The role of localities is even more pronounced, when we recognize that cities are also the major sources of new technology, economic growth and new environmental initiatives. Consequently, the role of the city is increasingly that of an animator of creative quality of life strategies.

Despite differences in development speed and quality of life, it is striking that almost all cities are growing and continue to grow. Large metropolises get bigger and bigger, and medium-size cities tend to move toward metropolises (see Brotchie et al.,1991, Dogan and Kasarda 1988, Lynch 1981). And for the time being, there seems to be no end to this world-wide trend. Apparently, agglomeration economies and urban network configurations are a strong force in the global urbanisation process (Van der Knaap 1997). Clearly, there are negative externalities involved in large-scale urbanisation (e.g. congestion, environmental pollution, criminality etc.), but apparently the economies of scale and density seem to be higher than the social costs of modern urbanisation. In the mean time, the awareness is growing that it is not the sheer size of a city which is the source of the problem, but improper management. If the latter conviction is true, then a positive view on the city is undoubtedly warranted, provided the city is recognized and treated as a spatial-economic entity

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which derives its strength and opportunities from a multi-dimensional package of challenges and problems, and which is not following a static rectilinear evolution but a flexible dynamic trajectory which has to be managed by a sound use of economic instruments in the context of learning strategies (Simmie 1997).

Against this background, it should be emphasized that cities are not passive spatial units victimised by anonymous global environmental developments, but may play an active role in producing sustainable development opportunities in a multiplicity of relevant fields, such as housing, employment or environmental quality. This promising profile of the city as a window of socio-economic opportunities is increasingly coming to the fore in institutional agenda formation for sustainable development, not only for the developed world but also for the developing world. This means that urban development planning has to address a wide variety of issues and objectives regarding the economy, the environment, the cultural heritage and the socio-economic distribution of costs and benefits. Clearly, there is not a uniform panacea for sustainable urban planning, as there are site-specific environmental, economic, political and socio-cultural conditions in all cities of our world. In addition, representation and participation of citizens and the business sector in all aspects of urban life are critical (cf. Healey and Williams 1993), as a sustainable city has to be created by people themselves and indirectly by their governors.

Sustainable city strategies may be varied in nature and may inter alia concern distinct economic sectors, social groups or land use in the city. In view ofthe threats caused by spatial environmental spillovers to other areas - a phenomenon also witnessed by concepts like the ecological footprint', weak/strong sustainability or external/internal sustainability - a coordinated policy is needed to prevent spatial imbalance in sustainability policy at all levels and in all regions of an open, interconnected network of cities or regions.

Seen from this perspective, the position of Third World cities deserves due attention (see Nijkamp 1995). Cities in the developing world are often facing a serious struggle for continuity and survival on the basis of short-run economic interests. Even though it is widely recognised that favourable environmental quality conditions are a sine qua non for long-term sustainability, rational short-term survival strategies prevent many cities from developing a co-evolutionary strategy in which economic interests are brought in harmony with the urban ecology. Poverty situations are - in the short run - apparently playing a more privileged role than the strive for environmental quality improvement on a long-term basis.

The current emphasis in the sustainability debate on the local level of policy-making is conceivable and in recent publications a more thorough justification has been given for the necessity to develop sustainability policies at a local level. In the context of sustainable city concepts it has to be recognised that in most developed countries the majority of the people live in urban areas and that most value added is generated in urban-economic activity spaces. Consequently, also a significant share of all pollutants is generated in urban areas. Hence, it seems to be a promising departure to regard cities as focal points for analysis and policy regarding local and global environmental quality problems. Most environmentally damaging emissions are caused by human activities (e.g. industry, consumption, transport, etc.), though, of course, not all of these are the result of our 'urban way of living'. But the specific lay-out and life style of cities or urban areas does generally and world-wide cause various types of unnecessary greenhouse gas emissions. Motorized transport is of course a major contributor to such emissions, but also related activities such as industrial activities, the built environment, waste management, (lack of) district heating or combined heat and power technologies may exert a significant influence. While the reasons for advocating an intensified environmental

action at the urban level are more and more accepted and clear, the question how to overcome such concerns is still fraught with many difficulties. The aim of the present paper is to formulate some policy guidelines - based on economic principles -for a 'sustainable city'. It will argue that a sound economic basis of urban sustainability policies - with a strong orientation towards market principles - is a promising departure for improving quality oflife, both locally and globally.

It should be noted that the general concept of 'sustainability' is rather undefined and fuzzy, witness all the great many definitions which have been given. Consequently, the sustainability notion still provokes many scientific and political debates (see Van den Bergh 1991, 1996, Van Pelt 1993, Van Pelt et al. 1995). The present paper will not extensively address semantic questions on the terminology, but use a different starting point.

In this paper we will mainly interpret urban sustainability against the background of conflicting force fields which have to be brought in harmony with one another. in order to ensure long-term co-evolution. Consequently, we will often use the notion of 'co-evolutionary city' in the remaining part of the paper.

The Co-evolutionary City in a Triangular Force Field

A Triangle of Forces

A co-evolutionary city presupposes continuity in change, instigated by a conflicting force field, ranging from global to local levels. Sustainability forms the foundation for co-evolution of the city. It should be noted however, that sustainability does not only refer to environmental protection, but embraces also *economic and social aspects*. As the well-known Brundtland report "Our Common Future"(1987) states: "..a process of change in which the exploitation of resources, the direction of investments, the orientation

Table 1. A Typology of Externalities from Interacting Urban Force Fields

	Interaciton between economic and physical force fields	**Interaction between economic and social force fields**	**Interaction between social and physical force fields**
Positive externalities	Efficient energy use Efficient use of non-renewable natural resources Economies of scale in the use of urban environmental amenities	Accessibility to qualified housing facilities Accessibility to qualified jobs Accessibility to social amenities Accessibility to social contacts Accessibility to education facilities Accessibility to health services Diversification of options	Green areas for social amenities Residential facilities in green areas Accessibility to urban environmental amenities
Negative externalities	Depletion of natural resources Intensive energy use Water pollution Air pollution Depletion of green areas Traffic congestion Noise	Forced suburbanisation due to high urban rents Social frictions on the labour market New poverties	Urban health problems Depletion of historical buildings Loss in cultural heritage

Source: Capello 1996

of technological development and institutional changes are made consistent with future as well as present needs"(p. 46). This implies that the environmental utilisation space has to be related to social and economic factors as well. Furthermore, we ought to recognize that sustainability relates to *a dynamic, balanced and adaptive evolutionary process*, i.e., a process in which a balanced use and management of the natural environmental basis of economic development is ensured (Nijkamp and Perrels 1994). A basic underlying principle may take for granted that the stock of natural resources should not be depleted beyond its regenerative capacity, a principle according to which sustainability is traditionally interpreted (see Opschoor and Turner 1994, Pearce et al. 1989). This implies essentially a dynamic carrying capacity of a complex spatial-environmental system.

In linking the above remarks to the concept of a co-evolutionary city, we have to appreciate that all over the world any city is by definition an artifact environment, where the natural environmental aspects have already been sacrificed for the creation of urban modes of living. Consequently, a co-evolutionary city requires an equilibrium between socio-economic and environmental driving forces in a given geographical area. In this context, the positive aspects of a modern city, originating from the agglomeration advantages (synergy) of the city have to be fully recognized. These positive aspects stem primarily from the social economic environment of a city and provide an explanation for the existence and continuation of this efficient and intricate organisation of space and time for all human activities over the past centuries. We may quote here Haughton and Hunter (1994) who talk about the modern city as "one in which its people and businesses continuously endeavour to improve their natural, built and cultural environments at neighbourhood and regional levels, whilst working in two ways which always support the goal of global sustainable development"(p.27). Their definition means that the concept ofa sustainable city is a multi-dimensional one and also related to higher geographical levels. On the other hand emphasizing the outcome of the use of local resources, for both consumption and production purposes, viz. the level of welfare or per-capita income, we may argue sustainable development of the city is "a development which ensures that the local population can attain and maintain an acceptable and non-declining level of welfare, without jeopardizing the opportunities of people in adjacent areas" (Nijkamp and Opschoor 1997). In a city three different force fields coexist, the *physical (natural and built) force field*. the *economic* force field and the *social* force field, each of them explaining in part or in combination the existence and continuity of a city. All three force fields generate advantages and disadvantages for the city, i.e. user benefits and costs of a city. They all interact with one another and represent or express at the same time goals, means and constraints to human action in the city (cf Camagni 1992, 1994, Camagni et al. 1997, Capello 1994). The agglomeration economies of the city have an impact on costs and revenues of economic actors, in particular a reduction in production costs, a reduction in transaction costs, an increase in the efficiency of production resources, a valorisation of production, and a reduction of uncertainty.

Urban evolution and form is thus contingent on a set of three forces, each incorporating positive and negative elements. The relative balance of these forces is decisive for spatial pull and pull effects. These notions are brought together in Table 1. A city is not only a static configuration, driven by maximisation of the net cross-externality effects of each of the three forces on the other two, but exhibits also *dynamic pattern* in the form of a co-evolution of the three abovementioned force fields in a balanced perspective. We will now concisely pay attention to the static and dynamic aspects of co-evolutionary city.

A Static Perspective

In this section we will address the static interactions in

our co-evolutionary urban force field. The interaction between the *economic* and the *physical* environment in a city is usually characterised by negative externalities. The negative effects generated by economic activity within the city on the natural/built environment are well known: depletion of natural resources, noise, water and air pollution, destruction of green areas, traffic congestion and intensive energy use are all negative external effects caused by excessive economic activities in cities. Given the role of cities as concentration points of economic action, they are by definition the place where an intensive presence of environmental detriments, as such greenhouse gas emissions of carbon dioxide. nitrous oxide or methane, can be found.

But we have to recognise that many of these negative effects are only highly visible because of a mass effect and a density effect: if the same mass of economic activity were to take place in a more diffused territorial pattern, the spatial concentration of emissions would be lower, even though the absolute consumption of some natural resources (e.g., energy and soil) would be much higher. In other words, concentration of activities and proximity is not only a precondition for social interaction and economic efficiency, but it is also the source, up to certain levels, of increasing returns in the use of scarce, non-renewable resources.

The usual paradox is however, that because of the mass density of environmental externalities in city areas urban inhabitants are tempted to move out of the city, with the necessary consequence that individually their level of well-being may rise, so that at an aggregate level in a broader territorial setting the volume of environmental pollution will rise due to lower scale advantages and more transportation (cf. the notion of "ecological footprint"). This is a clear example of the well-known social dilemma in public choice theory.

The interaction between the *economic* and *social* forces gives rise to specific positive and negative external effects. The positive effects stem from accessibility to social services, such as education, health, social amenities (theatres and cinemas) and qualified jobs. On the contrary, agglomeration diseconomies may cause negative external effects on the social environment by imposing, for example, suburbanisation due to high urban rents, class segregation, new poverties and inertia in social class division. Social negative externalities may influence in a negative way the economic environment, by generating various frictions on labour markets, urban conflicts or a repulsion of firms considering a move into the urban area.

The last interaction deals with advantages and disadvantages stemming from the physical and social force field. Various examples can also be given in this respect; green areas for social amenities are environmental resources which have a positive impact on social welfare. On the negative side, depletion of historical buildings, loss of cultural heritage or urban health problems are examples of negative effects of the physical environment on the social one in a city area.

A "co-evolutionary city" is - in light of the above observations - now first of all a city where the three force fields characterising an urban agglomeration interact in such a way that the sum of all positive externalities stemming from the interaction of the three force fields is larger than the sum of the negative

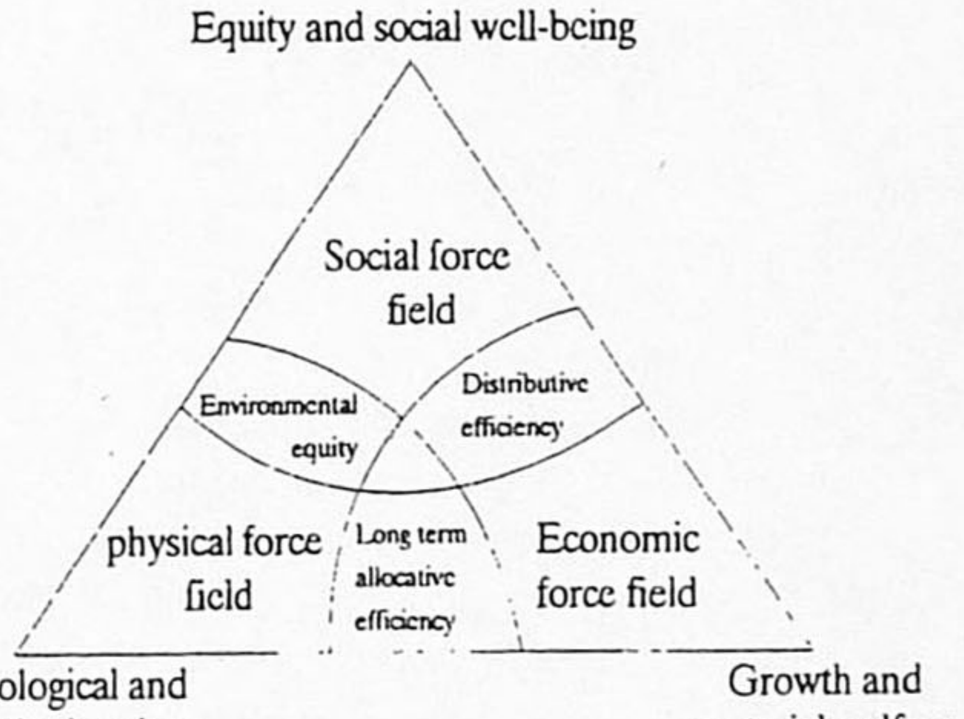

Figure 1. A Triangular Locus of Co-evolutionary Forces

external effects caused by the interaction. A "co-evolutionary city" is a city in which agglomeration economies should possibly be associated with positive environmental externalities and social network externalities, and in which at the same time negative effects stemming from the interaction of the three different environments should be kept within certain threshold conditions associated with the urban carrying capacity on the urban environmental utilisation space (Nijkamp and Opschoor 1997). Clearly, the balance between positive and negative benefits is not fixed, but in a state of flux.

A Dynamic Perspective

A balanced co-evolution of the three above mentioned forces constitute the basis for continuity of society (and of the city). But it is still an open problem how this co-evolution may take place, in a spontaneous or planned way. Ethics, equity, regulations or market incentives are often considered alternatively as elements that have to be accounted for in order to ensure a true sustainability for economic development of modern cities.

Seen from this perspective, the condition under which such a co-evolution can actually be reached is a transformation and an integration of the regulatory principles governing the three force fields (see Figure 1). The pure short-term market profitability regulating the economic sphere cannot be sustained, in the presence of environmental externalities and in the absence of market signals referring to future markets and future generations; the same holds with respect to pure equity and welfare policies, or to pure ecological ad aesthetic regulations, which do not account for government failures, economic disincentives and high opportunity costs of intervention policies. A further shortcoming of pure or extreme eco-policies may also be found in equity considerations, in that it may easily happen that these policies bring only benefits to a part of total society, namely the one that could afford paying for easier access to environmental assets (or paying more pollution rights); affluent classes in the case of households, and firms acting in monopolistic or oligopolistic sectors in the case of economic activities in the city.

Pure short-term profitability principles should evolve into *long term allocative efficiency*, through the internalisation of negative externalities, the embedding of proper behavioural rules with respect to the environment into common business practices, and the adoption of a long term perspective in the allocation of resources and in the definition of benefits and costs. The resort to market principles is maintained as the most effective way of allocating resources; but the market system is enriched in order to take into account - through subsidies, taxes and some regulations - the cases where a pure market fails or does not exist or does not operate on a sufficient time horizon. The direction is towards the construction of what philosophers and theorists of justice call the *"good-market"*, incorporating environmental considerations in the same way as our current labour markets incorporate modern working and wage conditions of a welfare society.

As far as the integration between the principles regulating the environmental and the social sphere is concerned, an *environmental equity* principle would have to be developed, guaranteeing both inter- and intra-generational fairness. While the former is generally underlined in many current environmental debates, opening the way to a risk of inter-generational paternalism, the latter looks particularly crucial, in that not just provision of environmental assets should be secured, but also the fair social accessibility to these assets. In the absence of this, environmental policy would risk to become the public provision of luxury goods. Equity in terms of income distribution is quite a different matter; here we draw attention to the substantial inequalities in access to e.g., land, water,

energy, environmental and sanitation facilities. In Third World cities this problem is not related only to social services, but also to the basic urban environmental services, such as clean drinking water, sanitary facilities and solid waste collection. The degree to which these services are available in all cities and all parts of the cities should be driven by environmental equity. This is especially true for the poorer segments of the population in Third World cities. Urban sustainability policies should address these differences in resource endowment by either enhancing the level of supply of public facilities (e.g. water, electricity, housing, sanitation) or by defining and (more equitably) allocating private property rights to environmental assets (Nijkamp and Opschoor 1997). Clearly, this opens up a wide array of research questions.

In the third place, the integration between profitability and equity principles calls for a distributive efficiency: this means operating through redistributive mechanisms in order to secure social stability, fair access to education and health services, wider access to options of economic upgrading and vertical societal mobility. A co-evolutionary city is not a city of equals, but requires a wide accessibility to those basic elements that allow the continuous regeneration of its professional basis and its creativity potential with a view on long-term continuity.

The Co-evolutionary City and the "Locality Theorem"

It has been argued in the previous sections that cities, as the locus of modern economic and social relationships and the main concentrations of production activities and human interaction, are almost by nature the main producers of co-evolutionary policies.

Cities are by nature open systems, impacting intensively on other areas and on the earth as a whole. In fact, although a wide part of environmental problems originating from the internal operating mechanism of cities are felt at the local level (pollution, congestion, noise, decay of the visual environment), nevertheless many effects exist that have a *transborder* nature (e.g. waste water flows, waste disposal) or a global one (contribution of traffic and heating emissions to greenhouse effect and global warming). Thus, there is a wide geographical coverage involved in urban co-evolution.

In the light of a co-evolutionary policy, the interlinkage of local/transborder/global problems originating from territorially limited units might present an advantage: that of *operating locally with a global advantage*. In fact, cities may be regarded as efficient starting points for sustainability policies, not just in the trivial sense of the size and spatial concentration of the problems they imply, but mainly because i) cities offer an institutional framework for coping with tailor-made local actions, particularly fitting with the diversified nature of sustainability issues (*institutional efficiency*); ii) cities fit very well in the decentralisation movement in public policy, and are able to motivate more directly local actors like citizens and industries (*subsidiarity*); iii) cities are also administrative units responsible for data collection, so that applied and policy-relevant research can more easily be undertaken at the urban level (*monitoring and assessment efficiency*) (see also Nijkamp and Perrels 1994).

The question is now whether a proper administrative level for co-evolutionary policy can be identified. Cities - and localities in general - may become efficient centres for co-evolutionary policies as a consequence of another element stemming from the economics of environmental action, which may be described by the following "locality theorem": "the more local the problem (be it by nature, by convention or by policy-maker's choice) the more a sustainability policy can rely on (good-) market principles". As a result of increasing "locality" we may generate the following beneficial impacts of such a policy:

- an increasing identity between polluter and victim, and therefore a higher willingness to avoid the damage or to pay for environmental protection;
- in cases of low number of polluters, it is easier to apply a "polluter pays" principle;
- in the case of many polluters, population is more homogeneous, with more homogeneous goals and needs, and therefore consensus on environmental protection and taxation is more easily reached;
- property rights *á la Coase* could be more easily advocated and implemented in case of local commons than in case of global commons;
- it is easier to establish good-market rules reflecting local population ethics and goals, in order to internalise externalities;
- some specific environmental goals may be achieved through the existing free market: some localised environmental assets may be seen as luxury goods, for whom some specific sub-communities might be eager to pay a price; given the positive externalities and transborder effects, the provision of these assets could be beneficial to a wider part of the local community (even though we cannot avoid an equity problem here);
- the smaller the territory under scrutiny, the higher transborder mobility of both population and economic activities, and therefore, local communities may be more eager to place a premium on environmental assets, in order to maintain or attract residential and economic activities;
- particularly in peri-urban sites, supra-national, national or local incentives to maintain a natural landscape and agriculture-related activities may be

Table 2. Tools and Goals of Urban Co-evolutionary Policies

Policy Fields	Technology		Land Use	
Measures and Goals	**Short run**	**Long run**	**Short run**	**Long run**
Market-based Measures	Incentives to use less polluting transport means Tax on energy resources Discriminatory prices and taxes on energy Marketable emission rights	Incentives to R&D in environmenta-benign technologies	Incentives to mass transit use Pricing on scare resources (parking, road pricing) Incentives to provide and use technologies against congestion (traffic control systems)	Incentives to reuse derelict ares Mass transit devlopment Long distance transport means provision
Institutional Measures	Discriminatory pricing in regulated services	Limits in the use of specific polluting technologies	Regulation for congested areas	Regulation for unused land Public transport provision Land development regulations Regulation for the use of certain materials
Goals	Input substitution	Environment-benign technological change	Change in mobility patterns and modal choice	Change in urban form

activated (like the ones guaranteed by the EU), in order to enhance the profitability of environment-friendly activities with respect to urbanisation or speculative expectations (Camagni 1994b).

It is thus evident that the above mentioned "locality theorem" suggests that we should tackle urban environmental policies under a locality (or urban) viewpoint: an easier consensus can be obtained when local quality of life and congestion costs are under scrutiny, rather than when global greenhouse effects are prophesised. To the citizen, these latter effects are uncertain in terms of importance and causal chain, do not impact directly on their welfare function, and above all depend on parallel measures implemented independently and voluntarily by other communities (the prisoner's dilemma). But even if substainability policies are implemented for the sake of local interests, they turn to be beneficial also at the global level. In conclusion, there is an unprecedented scope for active, co-evolutionary city policy initiatives.

Elements of a Co-evolutionary Policy

Introduction

It should be recognised that our world turns to an urban world. For example, approximately eighty percent of the population of the EU lives in urban areas, while more than twenty percent lives in large cities of more than 250,000 inhabitants. This means that the "urban way of living" is the dominant form of "residential style". Industrial activities are to a large extent also concentrated in and around urban areas. And finally, by far the largest share of mobility flows takes place in urban areas as well. Consequently, cities (or, in general urban areas) are to a large extend responsible for pollution emissions, including greenhouse gases such as carbon dioxide, nitrous oxide, methane, CFC's, etc. In the past decade, many efforts have been made to develop - with more or less success - *sectoral* environmental policies (e.g. concerning industrial manufacturing, household consumption, transportation), but so far the city - as a natural "niche" for energy/environmental management - has never been the subject of a comprehensive action-oriented sustainability strategy. This paper will now deal with the question how to design and assess policy strategies for turning cities as environmental problem areas into spatial entities of environmentally sustainable opportunities. In other words, are cities "islands of co-evolutionary development in seas of decay"?

At the outset it shall be mentioned that the *time horizon* of urban action-oriented co-evolutionary policies is twofold; a short-term and a long-term horizon. The short-term horizon interprets policy goals as the selection of production factor mixes, transport modes and behavioural patterns oriented towards a more careful control on urban environment; it allows a substitution of less environment benign activities, behaviours and production techniques for more environment-friendly ones. The second time horizon which can be envisaged is a long-term horizon; in this case, co-evolutionary city policies are oriented towards a structural change in activities, behaviours and technologies. While in the first case, the goal is the substitution and selection of more sustainability-oriented urban actions, in the second case, the logic driving policy decisions is based on radical change and structural revision of choices related to urban activities, urban forms and technology over a long time horizon. We will now argue that two main fields of intervention policies may be envisaged for a city to drive it towards a co-evolutionary path; *technology and lan use* (see Table 2). Both policy strategies will now be discussed in more detail in the following subsections.

Technology Policy

The first and more common area of intervention is technology; a reduction in the use of polluting technologies is one way of keeping environmental

reducing pressure on the carrying capacity of the urban environment. As is the case for technological change, also land use may be managed in such a way that the spatial allocation of urban activities minimises energy consumption and pollution emissions without limiting economic activities or mobility.

Life-style

Finally, a third and less clearly identified field of possible policy interventions is personal *"life-styles"*; also in this area an urban co-evolutionary policy may play a role, although one can immediately foresee a much more limited space for these kinds of policies, since they impact directly on the private sphere and on behavioural choices of individuals. In advanced countries the present life-style is the result of increasing per capita income, and energy prices that do not include the full social costs of energy use. Private car ownership is high and increasing, as well as the density of electrical appliances per family. High mobility in leisure time is also something which belongs to common social behaviour in modern societies. All these habits may be influenced by urban sustainability policies, such as differenciated price of electric energy by hours of the day, so as to influence energy use for private needs in peak hours. Furthermore, long term policies should try to induce structural changes in social behaviour embedding more environmentally-oriented attitudes.

In Third World cities, on the contrary, low per-capita income and high social-class disparities determine different life-styles, more oriented towards daily survival, which might be influenced by a wider access to basic social services, such as education, health and sanitary infrastructures. All these services allow people to change their habits, to raise their standard of living and to avoid environmentally damaging social behaviour (Button 1992).

In the three above mentioned fields, and especially in the technology and land use field, there is ample space for urban co-evolutionary policies, also in Third World cities. Although the fields of possible policy action are clear and evident, other problems related to a co-evolutionary city policy remain open.

Co-evolutionary City and the Market

After the lenghy exposition of co-evolutionary principles and policies, the question emerges whether proper market principles can be formulated which support the notion of a sustainable city. From the previous reflections, some general points emerge as far as the urban co-evolution paradigm is concerned, namely:

- a co-evolutionary city purposes *an integrated concept*, encompassing at the same time economic, physical (natural and built) and social aspects, and imposing a favourable (balanced) co-evolution of the three environments sketched in Figure 1;
- *a balanced co-evolutionary development path* can be achieved by integrating the three bases or regulatory principles of each of the three force fields for co-evolution, while still relying on (good-) market principles. By this we mean that the short-term private profitability principle should be:
  - widened, so that also social costs and externalities may be taken into consideration (e.g. polluter pays principle) and a longer time horizon may be adopted by private decision makers (e.g. through incentives to R&D and long term technological change in the environmental sphere), and;
  - complemented by equity policies, in order to achieve a superior and long term effec-tiveness (what we have called "distributional efficiency") and to avoid the creation of new disparities and inequitable situations as far as the accessibility to (and the cost of) environmental assets is concerned;
- urban co-evolutionary policies should address the goal of enhancing the *positive cross-interactions among the three force fields*, and avoid or limit the

negative feed-back effects among them. In terms of the well-known trade-off between economic performance indicators and environmental quality indicators, this also means that policy intervention should aim at achieving an outward shift of this trade-off curve, at the minimum social cost.

Some further ideas on the above mentioned trade-off curve are in order now. The first refers to the real form of the trade-off between the economy and the environment, since in different contexts characterised by widely different levels of per-capita income, this trade-off curve could turn into a positive slope (see Figure 2). This statement can be supported by the following observations (Camagni 1996):

- in Third World countries, an increase in income levels, carrying along better housing, basic social services and basic infrastructure conditions, improved general education levels and organisational capability, may (almost) automatically imply an improvement of environmental conditions. This is in line with what the South Commission (1990) claimed, when it stated that poverty causes environmental decay;
- on the other hand, in affluent and advanced societies, environmental quality may be felt by households as a crucially needed superior good, and by firms as a necessary location factor. This observation is also supported by the environmental Kutznets curve.

If these conditions are met, policy intervention could concentrate on only one goal, namely the economic one, by capitalising the positive spillovers (at least at the local scale) on the environmental side. Clearly, there may be a time lag involved.

The second reflection regards the case where the trade-off curve between economic and environmental indicators maintains its traditional negative slope. In this case, a compatibility of economic efficiency principles (driven by growth objectives), social equity principles (driven by distributional objectives) and environmental equity principles (driven by ecological objectives) will normally require the identification of critical loads or thresholds for various relevant sustainability indicators at the urban level. This implies, for instance, that in the environmental field the total volume of permissible pollution in the urban area has to be assessed and specified, based on the concept of urban environmental utilisation space. Similarly, the mimimum acceptable level of economic performance (e.g. urban value added, urban employment) has to be assessed. Analogous targets on minimum distribution of resources (economic, environmental) may be set forth (e.g. by group, by urban district, etc.). This leads us to the notion of critical urban co-evolution, which defines the feasible area within which urban sustainability would have to take place. The distribution of environmental rights within these limits may be based on various allocational principles, using the integration of Table 2. Examples are:

- an equal percentage reduction of pollution in all sectors ("grand-fathering");
- a sector-specific reduction in pollution that is proportional to the environmental stress caused by that sector;
- a sector-specific reduction in pollution that is based

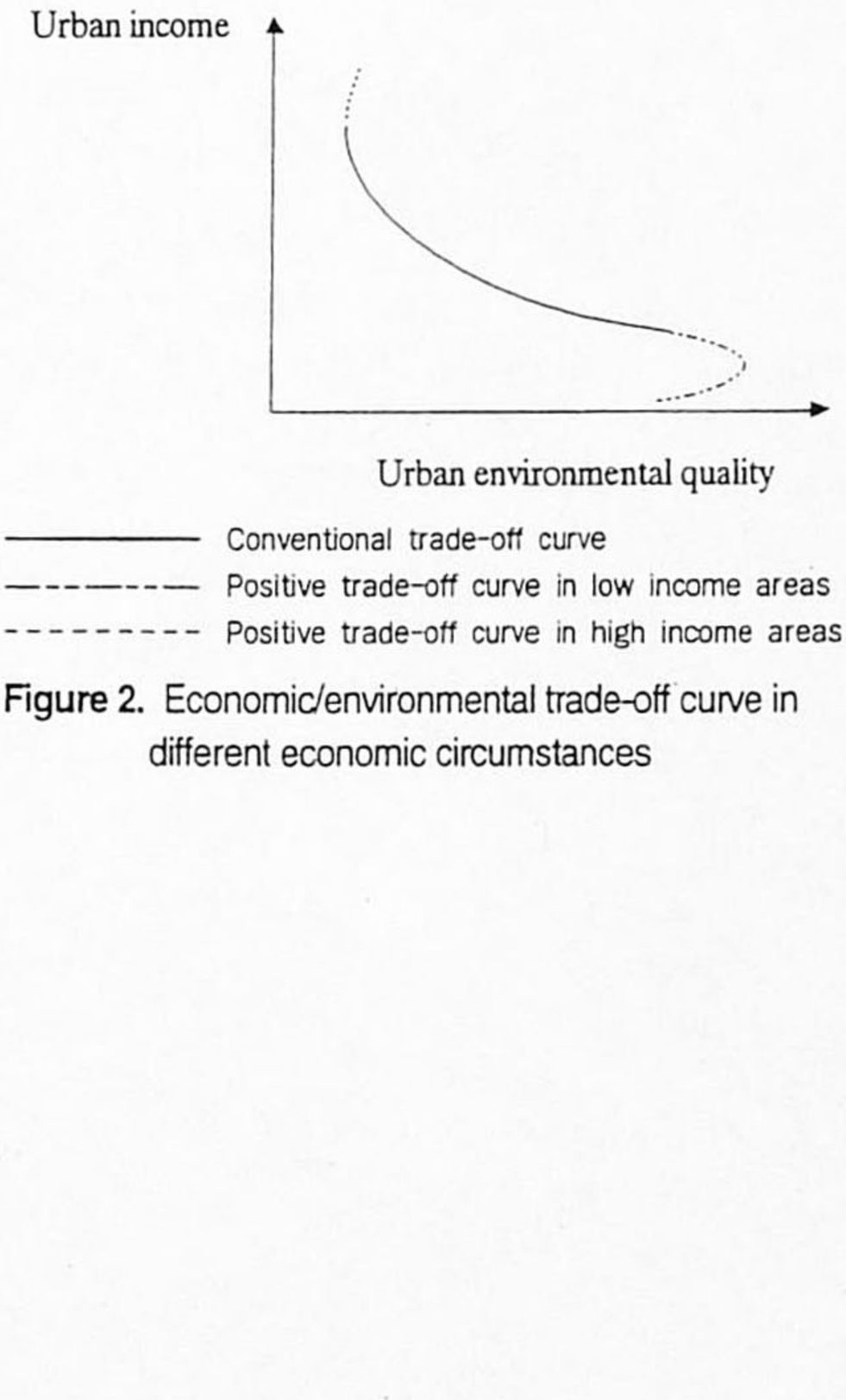

Figure 2. Economic/environmental trade-off curve in different economic circumstances

on sectoral cost-effectiveness measures for pollution abatement;
- a sector-specific reduction in pollution that is proportional to the growth rate of its pollution in the past years;
- a sector-specific reduction in pollution that is inversely proportional to its pollution abatement investments in the past.

It should be added here that institutional policy solutions (based e.g. on standards) do not seem to offer many perspectives for such trade-off problems, and therefore market-based tools may offer a much higher potential. Especially the idea of urban tradeable pollution permits seems to be promising here, as it will ensure that (Goddard 1995, Nijkamp and Vleugel 1995, Nijkamp and Ursem 1997):
- the overall urban critical environmental threshold is not violated;
- a cost minimising solution is found based on individual incentives for actors, and;
- transaction costs are included in the market based solution as well.

The tradeable permit policy ensures that not only environmental quality conditions but also distributional objectives can be achieved at minimum all-in costs. In fact, it allows a selective policy strategy with respect to different income groups or firms categories, whenever equity problems arise, acting on the initial distribution of pollution permits. Poor versus wealthy households, small versus large firms, competitive markets versus oligopolistic markets operating firms could receive special attention, according to the equity value judgement of the community. A co-evolutionary city policy would then need a) to establish critical values for the urban economy the urban environment and the urban equity; b) to organise the market for tradeable permits by establishing rules for all actors involved and by creating the necessary institutional framework in the city.

Retrospect and Prospect

The main propositions presented and advocated can concisely be summarised as follows:
- the concept of a "co-evolutionary city" is a complex concept which refers to the interaction of three critical force fields which characterise an urban system: the physical, the economic and the social force field. This interaction generates positive and negative external effects;
- in a static perspective, a co-evolutionary city is first of all a city where the three abovementioned force-fields interact in such a way that the sum of all positive externalities stemming from the intercation is greater than the sum of the negative external effects caused by the interaction;
- in a dynamic perspective, urban co-evolution means a balanced development of the three forces impacting on the city. The condition under which such a co-evolution can actually be reached is a transformation and an integration of the regulatory principles governing the three force fields. Firstly, pure short term profitability principles should evolve into a long term allocative efficiency, which guarantees a (good-)market incorporating the full social costs in the market prices. Secondly, an environmental equity principle should be developed, guaranteeing intra and inter-generational fairness. Thirdly, a distributive efficiency is called for, which requires operating through redistributive mechanisms in order to secure social stability, fair access to education and health services;
- three main fields of intervention policies for a co-evolutionary city are envisaged: technology, territory and life-styles. For each of them, short-term and long-term measures may be foreseen. The former find their rationale in a substitution of less environmentally-benign activities, behaviours and techniques for more environment-friendly ones. The latter are oriented towards a structural change in activities, behaviours and selection of more

sustainability-oriented urban actions;

- co-evolutionary city policies should address the goal of enhancing the positive cross-interactions among the three force fields, and avoid or limit the negative feed-back effects among them. In terms of the well-known trade-off between economic performance indicators and environmental quality indicators, all this means that policy intervention should aim at achieving an outward shift of this trade-off curve, at the minimum social cost;
- at a certain income level (i.e. either low or high) the trade-off curve has a positive slope. In Third World countries, an increase in income levels, carrying along better housing, basic social services and basic infrastructure conditions, improved general education levels and organisational capability, may (almost) automatically imply an improvement of environmental conditions. On the other hand, in affluent and advanced societies, environmental quality may be felt by households as a crucially needed superior good, and by firms as a necessary location factor. If these conditions are met, policy intervention could concentrate on only one goal, namely the economic one, monitoring the positive spillovers (at least at the local scale) on the environmental side;
- in front of the traditional trade-off curve between urban environmental and economic indicators, the problem is that in case of incompatibilities in critical threshold conditions the maximum permissable environmental load has to be reduced to a level where co-evolutionary development is guaranteed. In this situation, a tradeable permit policy ensures that not only environmental quality conditions but also distributional objectives can be achieved at minimum all-in costs. In fact, it allows for a selective policy strategy with respect to different income groups or firms categories, whenever equity problems arise, acting on the initial distribution of pollution permits. On the contrary, institutional policy solutions do not seem to offer many perspectives for such trade-off problems.

In conclusion, the idea for a co-evolutionary city is a challenging one. It provokes many new ideas for further research, but it also calls for a comprehensive policy view of the complex ramification of the modern city, which is not also a source of concern, but also of many opportunities, provided it is managed in a proper way with a wise use of market-oriented measures and initiatives.

Notes

1. Though the paper is the result of a common research work of the three authors, R. Camagni is responsible for Sections 2.1, 2.3 and 3, R. Capello for Sections 2.2. and 4, while P. Nijkamp for Sections 1, 5 and 6.

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